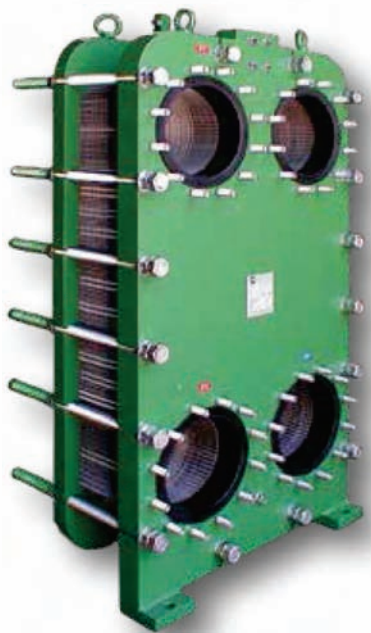


ANLAGENBAU
BÖHMER
HEAT EXCHANGER



www.anlagenbau-boehmer.de

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1.0 General Information

This manual applies to the regular model of the Böhmer plate heat exchanger. Please observe the job-related specifications in each case. Only operation personnel with specialist training and qualified servicing personnel are permitted to operate and service the plate heat exchanger. The operator must brief employees appropriately before the device is put into service.

1.1 User Instructions

Heat exchangers are pressure devices. These may only be connected, operated and serviced by qualified staff with specialist training.

The national and international guidelines relating to pressure equipment, hazardous liquids and gases as well as accident prevention and operational safety must be observed before putting the device into service. (Europe: *EU Pressure Equipment Directive 97/23/EC*
Germany: Operational Safety Law and relevant regulations)


1.2 Proper Use

Böhmer heat exchangers are designed on a job-related basis and to meet the requirements of the intended use specified by the operator when it comes to temperature, pressure, flow rate and flow media (for cooling or heating a medium) and they are manufactured in line with the conformity procedures of the EU Pressure Equipment Directive 97/23. Written confirmation must be obtained from Böhmer GmbH before making any changes to the device or operating it in a different mode. If this does not take place, the guarantee and liability claims may become void.

Considerable variations in temperature and pressure surges should, generally speaking, be avoided as these may lead to mechanical or material damage.

1.3 General Safety Rules

The following safety precautions must be taken to avoid injuries and damage to the device in general:

1. Instructions marked with a  warning icon must be observed at all times.
2. Appropriate protective clothing such as protective gloves and safety boots must always be worn while working with the device.
3. The exchanger must never be exposed to heat, aggressive chemicals or mechanical impacts.
4. Work may only be carried out on the device itself once it is no longer pressurised, it has been emptied and the temperature does not exceed 40° Celsius.

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2.0 Design and Function

The frame consists of a fixed and a loose pressure plate which are held together by two support bolts and tensioning screws. It is manufactured in standard sizes depending on the number of plates in the plate package. The plates are assembled in such a way that every second plate is rotated 180 degrees from the neighbouring plate in the same plane, whereby the ribs criss cross at a number of evenly spaced out bearing points. This results in considerable advantages in terms of strength and heat transfer. What's more, the plates cannot be deformed or damaged if the plate package is clamped. The crossed ribbing creates a very high degree of turbulence in the bundled layers, and results in a high coefficient of thermal conduction (K-value) and reduces the risk of deposits and blockage from e.g. sludge.

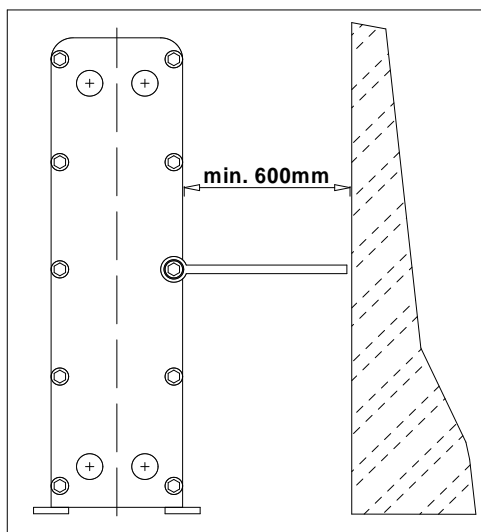
3.0 Installation

3.1 Setting up the Plate Heat Exchanger

Once the plate heat exchanger has been brought to its final position, it is to be assembled on the floor or on a foundation (plant structure). The heat exchanger should only be fixed to the ground using the holes provided in the frame feet. Changes must be agreed upon with BÖHMER!

The plate heat exchanger should be assembled with extra space on both sides, min. 600mm, making it possible to carry out all servicing and maintenance work on the device without problem in future.

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3.2 Environmental Conditions

The standard plate heat exchangers are designed for use in closed rooms away from the effects of frost. Special configuration would be required for an outdoor set up.

If the plate heat exchanger has to be stored outdoors, it must be protected from climatic influences such as moisture, sunlight and frost by means of an appropriate encasement. An anti-corrosion agent (e.g. grease) should be added to the tensioning screws.

3.3 Pipe Connections

The assignments of the connections of each plate heat exchanger take place on an individual basis and this is specified in detail in the job-related documentation. The connections of the exchanger are marked on the pressure plate as follows:

Medium A	-	IN
Medium A	-	OUT
Medium B	-	IN
Medium B	-	OUT



The heat exchanger may not be used as a prop or as a support for the pipes. Long or heavy pipes ending in the exchanger are to be supported by other props or holders. There is a danger that the connections may bend under the weight of the pipes, leaving these no longer functional or leaky. !

3.4 Shut-off Valves

Each of the connections should be equipped with shut-off valves to enable the opening of the heat exchanger if need be

3.5 Connections on the Loose Pressure Plate

Some heat exchangers have connections on the loose pressure plate too. These pipe connections should preferably be made with pipe bows which can be taken away easily, making it possible to move the loose pressure plate when the plate package must be opened.

3.6 Pumps

If the pumps reach a higher pressure than that allowed in the plate heat exchanger, they are to be provided with an adjusting valve. The intake of air by the pumps must be prevented. If the heat exchanger is operated at a higher pressure than permitted, or exposed to pressure surges from air intake, this can cause a defect in the seals and thus a leakage.

4.0 Putting into Service

4.1 Putting the Plate Heat Exchanger into Service

1. Before putting new PHEs into service, it should be checked whether the plate package is clamped at the right tension factor. Re-clamp as under 5.7 if need be.
2. Check whether the media, the pressure and temperature difference match the job-related specifications.
3. Check that the pipes have been assembled correctly.

4.2 Initiating the Device - Start-up

When starting up the heat exchanger, the two inlet valves are to be opened simultaneously and the rate of flow is to be increased slowly until the normal working temperature and the specified pressure are obtained.

Pressure shocks or fluid shocks must absolutely be avoided.

Take care that vibrations or pressure surges generated by pumps or similar devices do not transmit to the heat exchanger.



The plate heat exchanger must be checked for water tightness (visual check) and fault-free functioning (monitor operational data) by trained personnel at regular intervals (at least once a month).

4.2.1 Differential Pressure CAUTION!

The maximum differential pressure (see type plate) must not be exceeded when operating the heat exchanger, nor during potential pressure checks.

4.3 Ventilation

The air vent valves on the pipes should be opened during the slow start up, so that the existing air in the heat exchanger may escape. Following complete ventilation (achieved when the media exits from the outlet valve), the air vent valves must be closed again. If you fail to carry out ventilation when filling the plate heat exchanger, air cushions may form on the inside which will compromise the PHE's heat transfer.

4.4 Power Off - Shutting Down the Plate Heat Exchanger

The PHE should be stopped slowly by closing the supply valves. Close the flow direction with the higher pressure first or, if the pressure is the same, close the side with the hot medium first. If the heat exchanger is to be taken out of service for a prolonged period (more than 4 weeks), it must be emptied. Rinse or clean the plate package if necessary as described under 5.0. Then declamp the plate package. If there is a risk of frost or aggressive media, the heat exchanger must be emptied immediately after being shut down.



5.0 Servicing / Maintenance

5.1 Basic Instructions

The user instructions (see 1.1) and the safety instructions (see 1.2) must also be read before any servicing work.

The guarantee for the plate heat exchanger is 24 months. During this time, servicing and maintenance work may not be carried out without the consent of BÖHMER, otherwise the guarantee will become void. Here we refer you to our General Terms and Conditions.

Due to the various operating conditions and the variety of different media which may be used, the necessary servicing intervals vary. Therefore it is recommended that the plate heat exchanger be serviced in open condition at least once a year, in addition to the monthly visual inspection described under 4.2.

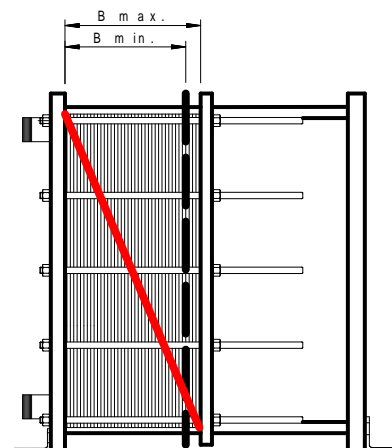
CAUTION RISK OF INJURY

Maintenance work on the PHE involves a risk of injury. So always bear the following points in mind:

1. Always wear suitable protective equipment (protective gloves, safety boots, safety goggles), the plates are sharp-edged - risk of cuts!
2. When using hazardous flow media (corrosive, toxic, combustible, explosive etc.) there is an acute risk of injury for the operator and bystanders. Ensure that the regulations for flow media are followed during all work.
3. If a pressurised or full plate heat exchanger is opened, the flow media may escape uncontrollably. In this there is a risk of injury for operators and bystanders. Ensure that the plate heat exchanger has adopted the ambient pressure.
4. There is a risk of combustion or freezing if very hot or very cold flow media are used. Always ensure that the plate heat exchanger has adopted the ambient temperature before beginning any maintenance work (e.g. by means of the temperature display on the ingoing and outgoing pipes).
5. Empty the plate heat exchanger and ensure while doing so, that the media in the plate heat exchanger is securely captured in line with environmental guidelines, in order to avoid pollution to the environment.

5.2 Opening the Plate Heat Exchanger

1. Rinse the outside of the plate heat exchanger. Carrier roller, top carrying bar and bottom plate guide.
2. Clean and grease the tensioning screws (this way the nuts can be loosened more easily later)
3. Note the current tension factor.
4. Mark the plate package at the side with a diagonal colour strip so that you can keep track of the right order of the plates during reassembly.

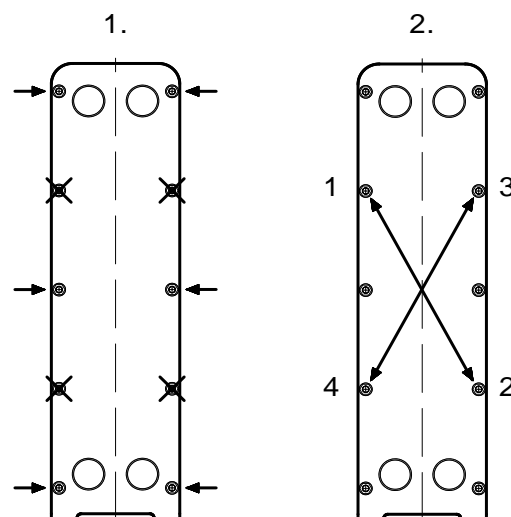


5. Take the tensioning screws out of the loose plate.

The first section of tensioning screws can be loosened in any desired order. Leave the four tensioning screws (1, 2, 3 and 4) for now.

Tensioning screws 1-4 are then loosened in diagonally opposing pairs at a time. In the process, in its inclined position, the loose plate may not exceed 10mm of its width and it may not exceed 20mm of its diagonal.

After all the tensioning screws have been loosened, the loose plate can be pushed back to the support (might be worth securing against slippage). Now the plates may be removed from the frame. Removed plates must always be worked on and stored in a lying position.



Never undo the tensioning screws on the fixed plate! Protective gloves should be worn when working with the plate heat exchangers because the plates may be sharp-edged. Only install and remove plates individually - risk of accident!

5.3 Cleaning the Plates

Light to moderate dirt can be removed from the plates with a high-pressure cleaner. Here it is important that you maintain sufficient distance, as otherwise the water pressure can cause the seals to come apart from the sealing groove. Light soiling of the plates can also be cleaned with running warm water and soft brushes.

Generally speaking, care should be taken when cleaning the plates to ensure that the seals are not damaged. Steel wool or steel brushes may not be used.

In the case of very sticky coatings, dirt on the plates can be dissolved using chemical baths. Cleaning chemicals should be selected which will not damage the sealing and plate materials. For this, please refer to BÖHMER to select a suitable cleaning agent

5.4 Replacing Seals

The seal is formed in one piece. The material is generally an elastomer which is selected on account of its suitability for the chemical and thermal conditions.

Our range includes two different types of seal design:

1. Non-adhesive (clip) seal. Old seals can be removed easily from the plates. The sealing groove should be cleaned carefully before inserting the new seals. The special pimples on the seals must be pushed into the corresponding holes on the plate.
2. Glued seals. To remove old seals, the plates must be warmed on the reverse side with hot air. Here it is important to ensure that the plates do not become overheated (heat tinting). For this reason, 150°C should not be exceeded. The adhesive becomes soft after heating and the seal can be removed.

The plates should be cleaned of adhesive and old sealant residue (with a blunt object -plastic or wood -**no metal**) as well as oil and grease. The relevant cleaning agent can be purchased from us with the associated safety data sheet

3. In order to ensure that the correct spare parts are ordered, every heat exchanger is issued with the relevant documentation on delivery. This lists the components of the exchanger with item numbers. This spare parts list must be stored away safely. Furthermore, data can be requested from BÖHMER using the serial product number with which every heat exchanger is issued.

The new seal is attached as follows:

Apply the glue to the plate in the relevant sealing groove using a small brush or our adhesive application set. Then insert the seal in the groove and push in by hand. Protective gloves must absolutely be worn in this work to avoid contact with skin. We recommend using disposable gloves for this. Adhesive sealant with the associated safety data sheet can be purchased through BÖHMER.

Ready-sealed plates should be stacked on a level surface (max. 60 plates on top of one another) and then weighed down with a level steel sheet.

At room temperature, the adhesive will set after approx. 12 hours. The setting time can be shortened with higher temperatures:

At 40°C reduced to 180 min

at 70°C reduced to 45 min

at 110°C reduced to 10 min.

After setting, excess adhesive should be removed with a blunt object.

5.5 Inserting the Rubber Bushing

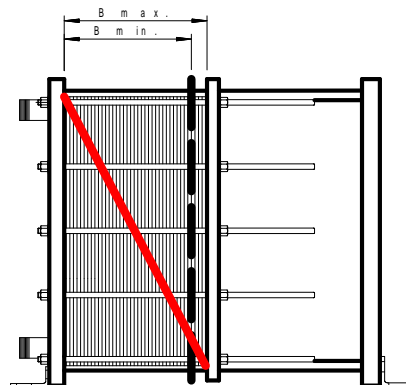
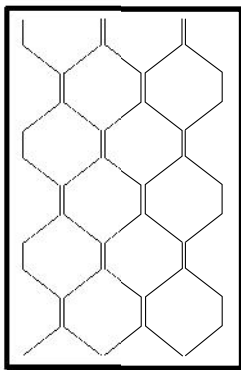
The rubber bushing is installed on the front side of the thrust plate by bending the bushing in order to push it inside through the opening. The rubber bushing must be laid out smoothly on the inside and placed in such a way (horizontal + vertical alignment), that the rubber ring on the bushing sits perfectly in the heat exchanger plate groove (only with the old design). The new design does not feature a rubber ring on the inside, therefore a complete initial sealing with 4 ring-seals must be installed.



5.6 Assembly

The seal and the plates must be carefully inspected before assembly. Dirt or particles which could lead to a leakage must be removed. If one or more plates have received new seals, it must be checked whether these are sitting perfectly in the guide. Before the movable thrust plate is pushed against the plate package, check to ensure that the plates are correctly fitted in the frame - the edges of the plates should then form a honeycomb pattern.

The colour strip applied before opening allows an extra visual check.



Protective gloves should be worn when working with the plate heat exchangers because the plates may be sharp-edged. Only install and remove plates individually - risk of accident!

5.7 Tensioning

The plate package must be tensioned up to a certain degree between the inner surfaces of the fixed and the movable thrust plates. This degree is calculated as follows: Number of plates x multiplier Please use the enclosed separate sheet "tension factor" to find out the relevant multipliers of the various heat exchanger types. Tensioning the plate package at less than B-min is not permitted. When the package is fixed at B-min, the metal of the plates are in contact with one another; a further tensioning could result in the deformation of the plates.

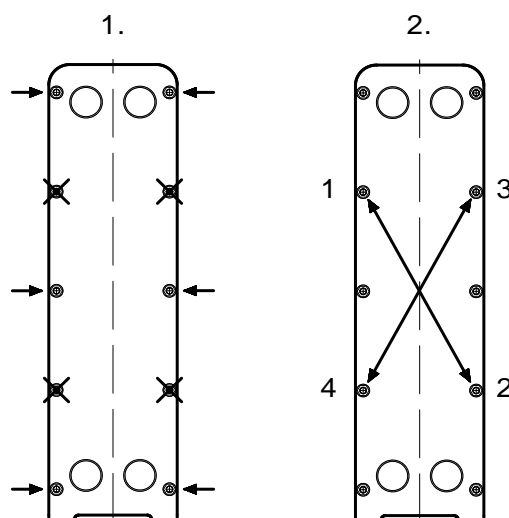
When tightening, ensure that the screw's torque is not exceeded. You can find a corresponding table with the respective torques at the end. Please refer to the job-related documentation for the size of the tensioning screws.

When tightening the screws, you must never tighten beyond the tension factor, even if the torque would allow further movement.

The moveable thrust plate must not be at an angle in the frame, it must always be moved parallel to the fixed thrust plate.

Not all tensioning screws need to be tightened at the start. You can begin with two screws on each side, namely with the two in the middle (1, 2, 3, 4) . This way the plate package can be tensioned to around 30 % above B-min.

Then the tensioning is continued with all the tensioning screws. The tension factor B-mas. is sufficient for new seals. After a prolonged operating duration, it may be necessary to re-tension the plate package in order to avoid leaks.



The heat exchanger must never be re-tensioned when pressurised!

The function and lifespan of the heat exchanger are highly dependent on the accuracy of the plate package tensioning.

6.0 Troubleshooting

LEAK between plate package and frame

Mark the spot with a felt pen or the like and open the heat exchanger as described under 5.2, observing all the safety instructions while doing so.

1. Check the condition of the seal on the end plate and, if applicable, the connection. Watch out for any potential damage on the seals.
2. Examine the surface of the thrust plate for unevenness, foreign particles stuck to it etc., which could destroy the connection between the seal and the adjacent surface.

Remedy:

1. Remove foreign particles.
2. Replace damaged seals.
3. Replace rubber bushing, if present.

Outward LEAK between the plates

Mark the leak area with a felt pen and measure and note the length of the plate package between the thrust plates (tension factor). Open the heat exchanger (see 5.2) while observing all the safety rules.

Inspect the plates:

1. Examine loose or damaged seals.
2. Check plates for deformation, pitting and cracks.
3. Sort faulty plates and/or plates with faulty sealings.

Remedy:

1. Restick or reclip loose seals. Replace faulty seals.
2. Take out faulty plates for repair or replace with a new plate.
3. When assembling the heat exchanger, observe the corresponding tension factor (see tension factor table and point 5.7).

Mixing of media - internal leak

Procedural steps for localising leakage

1. Observe the safety rules
2. Shut down pumps and leave device to cool to room temperature.
3. Empty the exchanger and open the lower pipe connection at the inoperative flow area. Apply light pressure to the opposite side (pipe pressure).
4. The leak becomes visible if liquid escapes from the opened connection. In this case mark the point externally on the plate package and proceed further as described under 6.0 -1 + 2.
5. Cracks or corrosion on the plate can be localised using a powerful light source (torch or headlight).
6. Tests with dye penetrants are required to detect very fine hairline cracks or holes in the plates. Refer to Böhmer in this case.

Remedy:

1. Replace the faulty plates
2. As a temporary solution, the exchanger can be operated with a reduced number of plates until a replacement is available.

Drop in performance of the plate heat exchanger

If pressure losses rise considerably or if the heat output falls significantly, you must first check if this is to be attributed to a fault in the overall unit. Check process and operational data.

If this is not the case, the plate heat exchanger must be opened and cleaned as described under point 5.0.

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Tension factor for plate heat exchangers

	0,4mm		0,5mm		0,6mm		0,7mm Safety plate-2x0,35mm		0,8mm		1,0mm Safety plate-2x0,5mm	
type	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
PAB 380			2,7	2,8								
PAB 401 + 402			2,75	2,85	2,8	2,9						
PAB 403, 405, 416 + 417	2,25	2,35										
PAB 404 + 406			2,6	2,7	2,7	2,8						
PAB 410, 412 + 414			2,9	3,0	3,0	3,1	3,1	3,2				
PAB 411			2,9	3,0	3,0	3,1						
PAB 415, 418 + 419			2,8	2,9	2,9	3,0	3,0	3,1				
PAB 420 - 424			2,9	3,0	3,0	3,1						
PAB 431,432,433,434,435,436+437			2,95	3,1	3,05	3,15	3,2	3,3				
PAB 448,450 - 452 - 552			3,8	3,9	3,9	4,0	4,0	4,1				
PAB 456, 457 + 458			3,9	4,0	4,0	4,1						
PAB 460, 461, 462 + 464			3,9	4,0	4,0	4,1						
PAB 470 + 472					3,3	3,4						
PAB 480 - 486									plates 0,9mm >>		5,9	6,0
PAB 490, 492 + 493	2,8	2,9	2,9	3,0	3,0	3,1	3,1	3,2	3,2	3,3		
PAB 491	4,2	4,3	4,3	4,4	4,4	4,5	4,5	4,6				
PAB 501 + 502			2,75	2,85	2,85	2,95						
PAB 510 + 514			2,9	3,0	3,0	3,1	3,1	3,2				
PAB 520 + 591			2,95	3,1	3,05	3,2	3,15	3,3				
PAB 531			2,95	3,1	3,05	3,2					3,55	3,7
PAB 541, 543, 544 + 545	2,8	2,9	2,9	3,0	3,0	3,1	3,1	3,2				
PAB 542	4,1	4,2	4,2	4,3	4,3	4,3	4,4	4,5				
PAB 550			3,3	3,4	3,4	3,5	3,5	3,6				
PAB 556, 557 + 558			3,35	3,5	3,45	3,6	3,55	3,7			3,85	4,0
PAB 560			3,55	3,7	3,65	3,8	3,75	3,9				
PAB 590, 522, 523 + 524			2,95	3,1	3,05	3,2					3,45	3,6
PAB 612					3,2	3,3	3,3	3,4				
PAB 614			4,2	4,3	4,3	4,4						
PAB 615			3,65	3,72	3,75	3,82						
PAB 622 + 624			4,2	4,3	4,3	4,4						
PAB 651, 653, 661 + 663			3,55	3,65	3,65	3,75						
PAB 656, 657 + 658			2,95	3,1	3,05	3,2						
PAB 703	2,5		2,6									
PAB 705	2,9		3,0									
PAB 712	3,3		3,5		3,5							
PAB 714	2,25		2,35		2,45							
PAB 718, 730 + 735	3,65	3,75	3,75	3,85	3,9	4,0						
PAB 720	4,3	4,5	4,4	4,6								
PAB 724					3,1							
PAB 732 + 740	2,1		2,2		2,3							
PAB 736	4,3	4,5	4,4	4,6	4,5	4,7						
PAB 772 + 774	2,7	2,8										
PAB 744			4,8	5,0	4,9	5,1						

